JELDU

1. Intro

Jeldu Woreda (district) is located in West Shewa Zone of the Oromiya National Regional State, 115 km west of Addis Ababa. Jeldu's 202,655 people are scattered across a highly variable landscape of highlands (45%), midlands (30%) and lowlands (25%) covering an area of 139,389 hectares (ha). Land is divided up into small allotments among the population with the average household of 7 people possessing 2 ha of land. Short rains known as 'belg' rains occur between March and April while the main rainy season begins in mid May and last until the cropping season in mid September. The majority of residents live on ridge tops and cultivate steep valley slopes of up to 80 degrees of which oxen are replaced by hoes for tilling.

To adequately gauge the various issues surrounding land degradation and food security issues in Jeldu, it is important to grasp the differing agro-ecology of the woreda. Three distinct agro-ecologies exist in Jeldu with the types of crops grown, agricultural use patterns, soil type, dominant tree species, etc. differing in each respective area. In the highlands for example, the primary crop grown is potatoes with wheat, barley and some legumes as well. The midlands on the other hand grow mainly teff, maize and wheat while sorghum along with teff and maize are mainly found in the lowlands. In addition to varying types of crops, each agro-ecology also maintains differing crop rotation patterns based on its unique ecological environment. Cereals such as wheat, barley and teff are rotated with legumes like faba beans and peas at two to three year intervals in the highlands. Farmers in the lowlands also rotate their crops in two to three year intervals but sorghum and maize are rotated with teff or oil seeds.

Another important feature of the woreda is its mix of crop production with livestock. While crop production makes up the bulk of farmers' livelihood at 70%, livestock production is also an integral means of livelihood both as subsistence as well as a source of income generation. Cattle are the most prominent livestock in the woreda, predominately used as draught power, with most households possessing 8 cattle on average. As 15% of the land is grazing land, farmers prefer open grazing but in recent years have encountered numerous challenges by shrinking grazing land. Various crops as described above are grown on the remaining arable land which makes up 43% of the total land in the woreda. Family members are typically used as labor and the land prepared using oxen-drawn ploughs. Farmers growing potatoes in the highlands however prefer to hire outside labor.

2. Natural Resource Management (NRM) Background

When conducting research and implementing projects in Jeldu, understanding the cultural and historical context surrounding Natural Resource Management (NRM) is vital to ensuring appropriate interventions. Like all rural areas throughout Ethiopia, agricultural trends are effected in large part by the politics of the time. Farmers have experienced numerous phases of agricultural management practices coinciding with the political agendas of the different ruling establishment. NRM intervention is not new to Jeldu. Soil bund terraces were built during the Derg regime in 1984/85 marking the first soil and water conservation intervention in the woreda. These conservation structures were later destroyed upon the current regime's rise to power in 1991. The perception by farmers of these type of top-down government interventions is that conservation efforts were politically motivated and not necessarily advantageous to farmers themselves. Other complaints by farmers were that terraces reduced the size of crop lands and proved unnecessarily laborious. Recently, the government has placed more emphasis on NRM activities and are being rolled out in 11 of the most drought prone and food insecure kebeles (smallest administrative unit in Ethiopia) in Jeldu Woreda. These activities include

stone bund terracing, raising and distribution of seedlings for agro forestry plantations and distributions of livestock fodder seeds/seedlings.

3. Livelihood Issues

In terms of crop production, eucalyptus tree planting and potatoe planting (highlands) stand out as the most dynamic livelihood issues in Jeldu. Although eucalyptus trees have been present in Ethiopia since they were first introduced during Emperor Menelik II's reign in 1894 to combat deforestation, it wasn't until 1996 that eucalyptus as a cash crop began to spread into Jeldu. The impetus behind the government's push for eucalyptus tree planting was in response to the shortage of firewood in rurual areas. However now eucalyptus is commonly seen by farmers as an export crop with 80% currently being grown for export. Eucalyptus is harvested every 3-7 years depending on whether it is used for fuel wood, timber appliciations are other purposes. The benefits of eucalyptus production is that it requires minimal labor compared to arable production and provides a good source of income as well as insurance against critical cash shortages. To the landlass as well, they are able to earn an income through assisting with harvesting, loading and unloading logs. However, farmers are realizing that there are also many negative reprucusions from eucalyptus production. First, instead of receiving fragmentated yearly incomes common with annual crop sales, one lump sum is recieved every 3-7 years. More concerning is the recent eruptions of community conflicts due to disputes over eucalyptus production rights. Without any laws governing eucalyptus planting, Jeldu has seen a rise of local conflicts which the local woreda government unable to handle these issues thus sending them up to the regional government. In terms of eucalyptus' effect on the environment, there are a number of issues including the trees massive water consumption, slow decomposing of leaves, deep and extensive roots and overtaking of lands for food crops. A potential solution to the economic as well as enviornmental impacts of eucalyptus plantations is to direct planting to degraded, sloped land and gullies to improve its protective service.

Potatoe produciton has also become a major livelihood issue of farmers in Jeldu, particularly in the highlands where the majority of potatoes are grown. In 2002 with the support of Holeta Agricultural Research Center, potatoe production expanded throughout the woreda. As potatoe production expanded, farmers moved production from gardens to fields helping make potatoes the highest income generator in the area, surpassing eucalyptus. While potatoe production has created a source of income for some farmers, it has also led to a number of problems. One of the greatest challenges concerns market instability. An exuberance for potatoe production has resulted in production exceeding demand. While farmers in some instances have destryed eucalyptus in favor of potatoes and potatoe cooperatives like darara (2008) have been established, there remains substantial risk for farmers in potatoe production. Yet, if ways are found to expand existing markets and create new ones, the benefits for potatoe farmers will increase.

In addition to crop production, livestock production also plays a key role in the livelihood of people in Jeldu. The vast majority of households have livestock, with one survey showing the possession of livestock of around 95% of households in the woreda (Birhanu 2011). Cattle are primarily kept for meat, milk and milk products in addition to being perceived as a store of wealth. Besides cattle, Jeldu residents raise sheep, equines and chicks. Over the years, the number and productivit of livestock have decreased. Because of the steep and gorge type topography of most of the grazing land in Jeldu, it is not suitabile for rearing livestock. This creates a major challenge for farmers in supplying adaquate feed for their livestock. Even crop residues used as livestock feed are insufficient so cattle are forced to feed off green leaves along rivers and streams. Water scarcity and long distance traveled as well as water bone diseases were cited among farmers as contributing to the reduction of the number and

productivity of livestock [From: Birhanu Ayana Tola. Assessment of rainwater management practices for sustainable developemnt and rural livelihood improvement in Andode/Meja Micro Watershed, Jeldu District, Oromia Region, Ethiopia. Ambo University, May 2011]. In response to the high mortaility rate of cattle in Jeldu, one NBDC report claims that management intervention in the time of harvesting and feeding of the local clovers and sorghum tillers could enable reduce mortality of cattle up to 40% in Jeldu [From: AYELE ABEBE. Nov. 2012. Small-holder farms livestock management practices and their implications on livestock water productivity in mixed crop-livestock systems in the highlands of Blue Nile basin: A case study from Fogera, Diga and Jeldu districts (Ethiopia). Hawassa University, College of Agriculture].

3.1 Food Insecurity

Food security also effects livelihoods of Jeldu residents. According to one NBDC survey, 35.5% of household respondents identified themselves as food insecure and 26.6% of respondents claimed that the food supply situation varies from year to year and season to season. Food scarcity is most acute during the summer season when grain supplies are used up and new supplies have yet to reach the residents. Major factors contributing to food insecurity included land scarcity for more grain and livestock production (72.6%); inability to produce sufficient grain due to poor RWM on crop farm and inability to intensify production via small scale irrigation (67.7%); and inability to rear sufficient number of livestock due to insufficient amount of water (52.4%). Also cited by some farmers as a reason for food insecurity is a meager income from non-farm activities (7.3%) [From: Birhanu Ayana Tola. Assessment of rainwater management practices for sustainable developemnt and rural livelihood improvement in Andode/Meja Micro Watershed, Jeldu District, Oromia Region, Ethiopia. Ambo University, May 2011].

4. Nile Basin Development Challenge (NBDC)

In order to address these as well as other livelihood challenges farmers face in rural Ethiopia, the Nile Basin Development Challange (NBDC) was introduced. NBDC project was initiated by the Challenge Programme on Water and Food (CPWF) in three woredas of Ethiopia – Jeldu, Diga and Fogera. The project alligns its work with the national programs of Ethiopia on improving rain water management strategies, policies and institutions for resilient livelihoods. Its works is comprised of fiver overaching strategic areas known as Nile 1 through Nile 5 (N1, N2, etc.). These five areas are: N1: Learning from the past; N2: Developing integrated RWM strategies; N3: Targeting and scaling out of RWM innovations; N4: Assessing and anticipating the consequences of innovation in RWM systems; and N5: Catalyzing platforms for learning, communication and coordination across the projects. N1-N5 were developed in a fashion that built off one another in order to build synergies between the various projects. In this way, a comphensive system could be developed to address livelihood issues in the target areas with the intent of scaling up throughout the country in the future.

In Jeldu, a wide range of NBDC projects have been rolled out since its inception in 2009. From innovative information gathering techniques like digital stories to state of the art polyscape GIS tools and hydrologic and crop yield modeling activities, a comprehensive system is being developed to tackle environmental and institutianl challenges that Jeldu farmers face for improved livelihoods.

4.1 Nile 1

Before the various activities were carried out, a comprehensive literature review was conducted to understand trends and outcomes in sustainable land management, soil and water conservation and rain

water management in Ethiopia since the 1970s. Results and recomendations from the study were presented in September 2010 at the NBDC kickoff workshop. The overarching conclusion is that over time the Ethiopian government learned from its experiences and adapted its approach to promoting RWM, moving from a top-down authoritarian policy that often pushed technologies not appropriate or acceptable locally, to a more consultative and participatory approach that broadened from a strict focus on reversing land degradation to one emphasizing improving people's livelihoods. But this evolution is not complete. The study makes specific recommendations on policy, implementation, and research to move toward a more demand-driven integrated approach [From: "Science Contribution Templates"].

In addition to the literature review, baseline research was conducted in all three field sites at the onset of the NBDC project. The overall NRM issues identified from this baseline research include focus on isolated technical interventions, lack of cross-sector collaboration and coordination, weaknesses in technical design, poor follow up and monitoring, lack of relevance to local priorities and lack of voluntary collective action.

4.2 Nile 2

A major component of the NBDC project is the establisment of multi-stakeholder innovation platforms (IP) to develop integrated rainwater management strategies. IP brings a broad range of stakeholders together ranging from government line departments to agricultural research centers, NGOs like Ethio-Wetlands and Natural Resource Association and community representatives to share knowledge, experience and skills on rainwater management. By providing a platform where governement workers, academicians and community leaders can work together for a common cause, an environment is created conducive to generating collective action through joint planning and action on the ground. The IP is closely alligned with the government's Growth and Transformation Plan (GTP), working to strengthen its objectives and implementation. The IP at woreda level works towards creating evidence through action research that will be documented and shared for the national level Land and Water Management (LWM) platform for influencing policies.

An important feature of the IP is engaging community leaders, farmers, governemnt and other key stakeholders in diaoluge. One of the platforms to doing this is through regular IP meetings centered on RWM issues held several times a year. Jeldu held its first IP meeting in September 2011 and involved representatives from the Woreda Office of Environmental Protection and Land Adminstration, Woreda Office of Agriculture, farmers, Holetta Agricultural Research Center, Ambo University as well as from ILRI and IWMI. Percpeptions of key land and water management related problems in Jeldu were voiced by each group. Researchers identified problems in terms of deforestation, soil erosion and land degradation while development agents (DAs) saw problems more in terms of farmers' lack of awareness and population pressure. Administration and office heads noted that the sloppy nature of the topography and illegal use of land were major impedements to effective water managment. Since the first IP meeting held in Jeldu, five subsequent meetings have been held with the last meeting taking place in May 2013. An increasing number of key stakeholders particpate in IP meetings adding to the complexity of collaboration but also opening up more opportunities to work together. Most noteably, HUNDEE, the IP's local facilitating organization participated has been a regular participant in the IP for the past year. HUNDEE donated Birr 30,000 to Jeldu's IP for the purchase of fodder planting material.

Landscape level priority areas in Jeldu are to control soil erosion, maintain soil fertility, avoid free grazing, controlled grazing, reduce shortage of land (give an opportunity for grazing land to be changed into farm land), control micro level climate, improve wildlife conservation, improve livestock

productivity and motivate farmers to introduce high yielding livestock breeds. These priorities were set as an outcrop of the baseline survey which identified soil erosion as the main problem and livestock feed shortage as one of the root couases for soil erosion. The survey also identified farmers' strong desire for the introduction of livestock feed varieties. This being the case and due to budget constraints as well as current government work on soil and water conservation in the area, NBDC IP focuses on livestock feeds as the primary means to combating soil erosion. ILRI allocated 83000 Birr to the woreda IP to conduct action research focused on these priorities.

In Jeldu, the IP has produced a range of activities involving various actors in the community and beyond. In order to ensure smooth project implementation, an IP member tehnical group was formed comprising of 7 expert members from different sectors. Tasks are assigned to different stakeholders according to their abilility. The type of tasks carried out in Jeldu include surveys, seedling variety selection and purchase, farmers' traning, drafting bylaws, etc. An important component of the IP in Jeldu, like Fogera and Diga, invovles the improvement of fodder development. Initially IP members were only able to identify 32 farmers to participate in the improved fodder project. However, by May 2013, 96 households were identified to take part in the fodder developemnt action research. Increased farmer interest and wider availability of planting materials were attributed with higher partcipant numbers. Four fodder varieties including Napier grass, Dasho grass, Bana grass and Tree Lucerne as well as 197,687 fodder grass splits and fodder tree seedlings were purchased and distributed. Dasho grass and Tree Lucerne proved the most effective. Since intervention, a positive change in attitudes toward soil and water conservation is evident. 30% of the target groups benefited from the established fodder plants at their backyards in terms of feed for calves and 70% of the planted fodder were on soil bund. However, more fodder is needed to supply efficient feed to all the animals.

In all three field sites IP participants have come together to identify and prioritize common RWM issues. In general, improved fodder development proved to be a major concern in all three pilot sites of which the Innovation Fund is currently supporting. IPs in each site selected small watersheds as pilot sites to carry out action research on fodder development. Famers were also carefully selected and efforts are underway to test a variety of fodder species development in different areas including on individual farm lands, back yards, communal grazing lands and soil and water conservation structures.

Concerning fodder improvement in Jeldu, many valuable lessons were learned over the course of implementation. First, timely release of funds and planting materials is key to the success of seedling plantations. Due to untimely release of finances from ILRI the fodder development project encountered problems in regards to seedling plantations. Secondly, sourcing planting materials have been shown to motivate farmers to grow fodder. Instead of establishing nursery sites which already exist in the area, the project can purchase the Dasho grass splits from the farmers growing them in their garden and distribute to new farmers. Thirdly, the local research center (HRC) and woreda livestock office forage experts are best suited to play the leading role in providing expert consultation to farmers during the selection of the fodder varieties and the planting strategy suitable for the area. Lastly, a formal participatory fodder evaluation with target farmers may be needed.

4.2.1 Local Knowldege

In 2011, a study was carried out to better understand the local ecological knowledge on ecosystem services of trees within farming landscaptes as well as the major drivers of land cover change across the three field sties. From July through August 2011, field work was carried out in five kebeles in Jeldu. Study locations were selected according to their agroecological location (highland, midland and lowland). Methods used during the study included open-ended questions used in individual and focus

group discussions, group exercises like pair-wise ranking of major drivers of land use change and its consequences and participatory sketching/mapping of historical land cover change. Results were analysed using AKT5 software and casual diagrams were generated to show relationships between land cover change and important biogeochemical processes within the landscapes, with a special focus on rainwater conservation services of vegetation.

As a result of the study, drivers of tree cover change and opportunities and constraints of tree planting are clearly documented. The results suggest that the farmers interviewed had a significant understanding of interactions between trees, soil, water and crops; nevertheless there was still a critical gap in understanding the long-term ecosystem services provided by trees. To design appropriate interventions we need to have a good understanding of the way that local people offer explanations and the reasoning behind them; this should facilitate effective communication while planning interventions. By exploring local knowledge, it also helps us to understand why farmers manage their systems in the way they do and what they would be willing to do differently given an incentive. The fact that important drivers of tree cover change are different across agro-ecologies strongly suggests that there is a need for designing and prioritizing interventions accordingly [From: "Scientific Contribution Template" Local Knowledge & AKT5).

Results of the study carried out in Jeldu showed that major drivers of land cover change with an emphasis on vegetation cover identified by farmers are socio-economic factors such as increases in population and government regime changes. Farmers identified expansion of agriculture and burning/clearing vegetation for no reasonable purpose as the two major causes for land cover decline. It was agreed among the farmers of different agroecological zones that the presence of vegetation cover affects water availability within landscapes in many different ways. While trees in general were seen as important for water conservation, farmers emphasized that not all species of trees had the same potential to conserve water. The report also showed that farmers acknowledge that a decline in vegetation cover can lead to a decline in rainfall. One of the most agreed upon elements pertainint to services of trees within watersheds was its soil protection services. Farmers identified the benefits of tree roots, litter fall, surface cover, etc. As important to maintaining healthy soil. As for eucalyptus trees, farmers appreciate its fast growth, high market demand, easy access to seedlings, its superior performance under moisture stress and degraded conditions. However, farmers also critisized the negative effects of eucalyptus on the environment as well other socio-economic factors.

Five recommendations were provided following the analysis. First, because of the contrast in farmers knowledge and practice, a detailed socio-economic and biophysical setting in the woreda may shed light on why these disparities exist. Second, fallow lands could improve productivity through the introduction of legume species based agro forestry practices or green maturing. Third, government policies that enforce land use planning based on land suitability need improvement. Fourth, further economic analysis that considers valuation of ecosystem services is needed to improve understanding of eucalyptus expasnion. Lastly, more actions need to be taken that lead to improved local access to native tree species seedlings.

Also it should be noted that the local knowledge assessment in Jeldu, unlike Fogera and Diga, focuses more on eco-system service trade-offs within the dominant land use and livelihood types of the upland kebeles to ensure outpus can be used to develop a provisioning layer for POLYSCAPE tool.

Another important study carried out during June and July 2012 in seven districts in the Blue Nile Basin, including Jeldu, examined issues surrounding innovation in the dairy sector. This study collected information by means of a household adoption survey where face-to-face interviews were carried out

from 669 randomly selected households. By modeling farmers' decision to simultaneously adopt interdependent dairy technologies in the mixed crop and livestock production system, it was found that the adoption of one technology is likely to influence the likelihood of adoption of another technology. The study also revealed that family work force, household's financial asset and household access to ICT, markets, agricultural extension service centers, land and livestock holding strongly influence farmers' decisions to adopt improved dairy interventions [From: "Scientific Contribution Template" Household Adoption Survey].

This survey was complimented by another study conducted in the area looking at institutional factors impeding farmers from usuing dairy technologies and taking advantage of business opportunities in Ethiopia's dairy sub-sector. Ulike the household adoption survey mentioned above though, this study drew from a wider range of sources including exant literature on the subject, policy documents as well as information collected from focus group discussions and key informant interviews in addition to household surveys. The results show that the underlining factor contributing to an underdeveloped dairy sub-sector is weaknesses in organizational competence to coordinate complementatry sources of knowledge and resources in livestock value chains. Thus, more attention must be directed toward organizational interventions in the dairy sector which can improve the coordination of technologies, skills, behaviors and processes.

Land and soil health surveillance also provided key information on the ecological landscape characteristics of the three field sites. The surveillance produced datasets on the Land Degradation Surveillance Framework (LDSF) and soil characteristics in addition to georeferenced maps of topography, vegetation cover, phenology, accumulated vegetation growth, length of the growing season, soil condition and land degradation. The LDSF surveys were conducted in collaboration with University of Addis Ababa and Mekelle University between May and July 2012. The LDSF is a spatially stratified, randomized sampling design, developed to provide a biophysical baseline at landscape level and a monitoring and evaluation framework for assessing processes of land degradation and effectiveness of rehabilitation measures, over time (From 13 Nov. 2012 "Updates on Outputs: Land Degradation Surveillance Framework (LDSF) Report). In November 2012 an update report of LDSF outputs was developed outlining the situation in the three study sites Lomicha, Woreta, and Gojo kebelas belonging to Diga, Fogera and Jeldu respectively. The preliminary analysis results for Jeldu show that more than 80% of the sites in Gojo (capital of Jeldu) are cultivated and the tree densitites are more variable in cultivated areas than in semi-natural areas. And as expected, the data shows that erosion prevalence is high in all sites including Jeldu.

4.2.2 Jeldu Exclusive Projects (N2)

As seen from the many activities outlined above, projects in Jeldu surrounding N2 (developing integrated RWM strategies) in general and the IP in particular cover a broad scope of activities. Specifically, the 12 separate components completed and/or ongoing under N2 are: follow-up adoption survey, digital stories, community engagmenet, household adoption survey, innovation in dairy sector, innovation platforms, innovation platform pilot intervention, livelihoods baseline, M4h initial RMS assessment for trees, participatory photography for M&E, site level hydrology modeling and SLATE tool. Of these twelve N2 components, two projects – digital stories and SLATE tool – were carried out solely in Jeldu. This provides a uniquge opportunity for stakeholders to evaluate the progress of these activities and make proper adjustments to the interventions before rolling them out in other areas.

Digital stories were rolled out in Jeldu from 2 households in Kolu Gelan kebele as part of the IP with plans to extend to Diga and Fogera as well. Digital storytelling is a communication technique used to

present compelling stories in an engaging format through the means of short films composed of digitized still and moving images, sound and text. In Jeldu these stories are used to document the progress of the IP pilot interventions over time as well as to capture the impact of the interventions through individual case studies and lessons learned for communication with wide range of stakeholders.

Another compoent of NBDC piloted exclusively in Jeldu with plans to extend to the other two field sites in August 2013 involves the SLATE Tool. SLATE is a tool which enables farmers to identify livelihood indicators using DFID sustainable livelihoods framework. Based on these indicators, livelihood data is collected using household surveys. Initially, training was conducted in Jeldu with representatives from each of the NBDC sites as well as representatives from Africa RISING sites. Following training, key informant interviews along with household surveys were conducted among a braod range respondents in 70 households throughout 3 kebeles. Currently, data is being analysed and those who already received training plan to use the tool to collect data in a similar fashion from Diga and Fogera in August.

4.3 Nile 3

Building off Nile 2's work of developing integrated RWM strategies through innovative platforms, Nile 3 aims to take these innovations and scale them out. N3 delivers outputs at two different levels namely by producing methods and maps for targeting and out-scaling specific technologies/strategies; and a set of maps and guidelines supporting strategic planning at basin and policy level (http://nilebdc.wikispaces.com/targ_scaling). One of the primary tools used to do this is Geographic Information Systems (GIS) of which it is not only able to be used by experts but a more user-friendly one can be used by non-GIS-experts to develop suitability maps and recomendation domains. A variety of maps have been produced which lay out bio-physical constraints, erosion potential and a spatial framework for setting priorities and targeting investments and interventions, etc. It is hoped that these types of information tools will assist in strategic planning at the basin and policy level.

To date, 12 separate components have either been completed or are underway in Jeldu under N3. As reported in the NBDC science contributions worksheet in April 2013, the 12 components are degredation hotspots, fire map, framework for targeting and scaling out, goblet GIS tool, happy strategies game, polyscape, rainfall maps, RMS adoption maps, RMS database, RMS suitability and feasibility maps, soil erosion maps, and spatial database.

The degredation hotspots component filled the gap in Blue Nile Basin (BNB) studies to examine the trends in land cover, land use and degradation at the basin scale. The work carried out under N3 combined biophysical and socio-economic factors to explain the trajectories of change and development which have occurred across the basin over the past 10-15 years [From: Nile Basin Development Challenge: Template for the most significant change story 2012]. A throrough analysis is underway of land use and cover changes and factors driving land change processes over the past years in order to characterize the development trajectories within the BNB. As part of this process, analyzing and mapping of fire was done over an 11 year period from 2000-2011. While burning is advocated by both government and farmers to increase soil fertility, this practice decreases soil fertility in the long term. Attesting to the potential synergies between the different Nile components (N1-N5), the focus on fire and burning within the basin was an outcrop of findings from N2's innovation platforms. As this issue continuted to crop up during discussions with stakeholders during N2 innovation platform discussions, N3 decided to adjust the work on development trajectories to incorporate a detailed analyssi of the fire regimes of the basin. The results of this study have recently been shared and because

of this agricultural burning is emerging as an important issue not only with the respective BDCs but within other basin research projects [From: Nile Basin Development Challenge: Template for the most significant change story 2012**]**.

4.3.1 Happy Strategies Game

Another participatory tool utilized to address N3's goal of targeting and scaling out of RWM innovations is the Happy Strategies Game. The game's objective is to identify a selection of practical strategies of Land and Water Management which could be applicable at a landscape level. It uses a participatory approach to come up with ways to narrow down practice database to specific landscapes; match practices to context/landscapes; develope strategies at landscape scale; and validate criteria of successful adoption of practices.

In 2011, stakeholders took part in the Happy Strategies Game during the NBDC stakeholder forum. Strategies were developed using NBDC's three field sites – Jeldu, Diga and Fogera – as "landscapes." Common objectives were identified across the groups with focus centered on fertility management, water harvesting and livestock oriented practices. Likewise, the most popular interventions included participatory approaches, access to credit and improving the value chain as well as agro-processing. Although the two groups for the Jeldu site developed different strategies, there were several common focul points. It was generally agreed upon that fertility management and soil and water conservation were the most important issues which includes shifting from eucalptus plantations toward a more diverse landscape. And despite Jeldu farmers propensity for planting eucalyptus trees, no agro-forestry oriented practice were proposed.

Along with participatory approach tools like the Happy Strategies Game, feasability maps and spatial analysis tools like GIS are a major component of N3. As seen from the degradation hotsposts component, fire mapping was able to confirm what farmers identified as a problem while at the same time to elevate burning as an important issue on the government's agenda. With all the various feasibility maps developed that combine biophysical suitability with willingness of adoption, there was a need to validate these maps. In order to understand why farmers do not adopt certain rainwater management strategies despite potential benefits, 600 farmers in 7 different watersheds of the Blue Nile were chosen to capture the farm scale and focus groups were carried out in 4 watersheds for the landscape scale. The watersheds selected were Gorosole in Ambo, Laku in Shambu, Maksenit in Gonder and Zefie in Debre Tabor [From: Matching land and water interventions with community needs: Report of community focus group discussions in four watersheds in Ethiopia; Compiled by Catherine Pfeifer, Dec. 2012].

In order for the supporting staff to better understand the boundaries and land-use dynamics of the watersheds, a transect walk was carried out before focus group discussions. A transect walk is a systematic walk along a defined path across the community/project area conducted by researchers and participants to gain an understanding of the water resources, wastewater flows and sanitation facilities of a location, their diversity and associated problems, and to assess opportunities (http://www.sswm.info/category/planning-process-tools/exploring/exploring-tools/preliminary-assessment-current-status/tran). Following a thorough assessment of the area, focus group discussions (FGD) were conducted. The FGD were based on a the Happy Strategies Game mentioned above and centered around three main steps. These were (1) Participatory mapping exercise in separate groups for men and women; (2) An adapted form of the ‘happy strategies’ game in separate groups for men and women; and (3) A group mixed discussion (men and women together).

Results of the exercise showed a wide range of potential entry points for rainwater management. In some watersheds, rainwater-related practices that are already in operation or that have been modeled were identified, whereas in other areas more unexpected practices were identified such as the use of poultry. Promising practices were also listed by participants in every watershed. For example, in Gorosole which borders Jeldu woreda, partcipants identified apple trees as the most promising practice. They would like to plant apple trees but do not currently have access to seedlings. However, it appeared that participants were not aware that apples need water during the dry season and must be combined with a water access. It was thus suggested that more training may be needed.

Complementing this type of participatory approach to community needs, GIS in general and the Nile-Goblet in particular are being utilized under N3 as a way to promote location-specific rainwater management. The Nile-Goblet is a newly developed open source GIS tool for suitability mapping. In December 2012, a learning event was held bringing together representatives from various government ministries involved in agricultural and water management to learn more about and test the Nile-Goblet tool. The Nile-Goblet in combination with participatory approaches being carried out as mentioned above will bring together expert knowledge into a participatory approach and improve planning with communities on the ground (http://nilebdc.org/2012/12/18/thematic-working-group-technological-innovation-hosts-its-first-learning-and-training-event-for-the-benefit-of-the-whole-national-platform-on-land-and-water-management/).

4.4 Nile 4

Assessing and anticipating the consequences of innovation in RWM systems is necessary to impove the performance of rainwater management systems interventions and identify the best options under different biophysical/socio-economic conditions. Nile 4 quantifies the consequences of improved rainwater management systems for community livelihoods, resource productivity, land quality, and downstream water quality and siltation. There are 4 primary objectives of N4: (1) To identify the cropping systems and existing crops management practices in the study area and relate to crop water productivity (2) To produce map layers of land use and crop types of the study watershed. (3) To estimate biomass and grain yields of major crops in each local agro-ecology and, (4) To simulate crop water requirements and calculate consumptive water use (m^3) of the major crops [From: NBDC Brief 5: Assessing and anticipating the consequences of innovation. Sept. 2010].

Under NBDC Nile 4, 8 separate components in Jeldu have either been completed or are underway. As reported in the NBDC science contributions worksheet in April 2013, these include APEX modeling-baseline and RMS alternatives, flow/sediment gauge data, cropping patern and crop water productivity, crop and livestock water productivity, integrated modeling-baseline and RMS alternatives, anticipating impacts and consequences, SWAT modeling-baseline and RMS alternatives (basin level), and WEAP modeling-baseline and RMS alternatives.

Important findings were generated from baseline data collected using a model for economic, social and environmental evaluation of land use called ECOSAUT. Baseline data from Jeldu was quantified using ECOSAUT, which is hoped to be used as a benchmark to assess impacts and consequences of rainwater management practices. If suitable rainwater management practices for the Jeldu site are identified and concretized (for example, using innovation platforms, participatory approaches such as wat-a-game, or the targeting practices of N3), such practices can be modeled to know the associated hydrological and crop yield impacts [Taken from the science contributions worksheet submitted in April 2013 on ECOSAUT].

In line with N4's objective to examine the relaitonship between biophysical and socio-economic processes, ECOSAUT was used to quantify sediment and run-off with net income and employment outcomes of current land use. The 4 major key finding are: (1) There is a high trade-off between income growth (socio-economic indicator) and sediment generation (bio-physical indicator). This implies that the current land use practice is unsustainable. Sustainable land use (and agriculture) needs successful management of such trade-offs. (2) In view of the non-drifting income growth trend observed over ten years period (for 2012-2020 as the temporal scale used in the model) the current land use scenario will not have a poverty reduction income effect over time (i.e., poverty will persist under the business as usual land use scenario). (3) It was found that land having the highest shadow price (implying that land is the scarcest resource in the area, perhaps suggesting the need for sustainable intensification through increased productivity per unit area). (4) If land is scarce, rainwater management can be considered as appropriate intervention to assist sustainable intensification by allowing multiple productions over a unit of land in a single production year and also by improving overall system resilience and productivity.

In addition to measuring the economic impact of rainwater management using ECOSAUT, N4 has used a varieity of modeling resources at different scales. Hydrologic modeling was carried out using the soil and water assessment (SWAT) tool. The objective of the SWAT model is to calculate the landscape flow and dediment contributions to the Blue Nile River system under various land use and RMS regimes. Simulations were run covering the period between 1971-2010 of 48 sub-basins in the Blue Nile Basin. For water resource management issues, the water evaluation and planning (WEAP) tool was used. The same periods were covered in WEAP modeling as with SWAT (1971-2010) in order to simulating reservoir operations in the Blue Nile River system. Through the use of WEAP, large-scale irrigation schemes can be seen and appropriate outputs can be applied such as regulated river flows, irrigation diversions and reservoir releases and storage.

The results of many of N4's data collection and modeling were undertaken by Masters of Science students. As part of N4's component to address innovation capacity building and dissemination, financial support and supervision was given to young researchers to carry out problem oriented research. A thesis by Asfaw Debela of Ambo University entitled "Assessment of effect of management practices and agro-ecology on water productivity of major crops in Meja watershed, Jeldu district, Oromia region, Ethiopia" is an example of this. Debela examines the effects of management practices and local agro-ecology on the water productivity of major crops grown under the rainfed system in Meja watershed, of which Jeldu is one of the field sites. The fieldwork was conducted from July 2011 to February 2012. Household surveys as well as group discussions were carried out in order to understand the farming emi-structured questionnaire to understand the farming systems, crops management and agronomic practices implemented by the smallholder farmers in the area.

The study found that crop roation was practiced on 91% of crop fields monitored, making it the cropping system of choice throughout the different agro-ecological zones. Only very limited typs of rainwater management practices were applied with farmers prefering surface drainage in all of the field sites. The vast majority of farmers also stuck to traditional methods of sowing and harvesting. Following the study, a list of 5 recomendation were provided. First, more capacity building for implementing improved crop rotation system for farmers is needed. Second, technical and material support for sustainable and equitable water use among small scale irrigation farming is needed. Third, trainings and awareness creation to use diversified and appropriate rainwater management pracices across the three landscapes is needed. Fourth, local and regional actors should work together to strengthen the development of the value chain for potatoes in the upper part of the watershed. Lastly, a more detailed study on the effects of crop management practice is needed.

Around the same time, another study by a masters student at Ambo University was conducted on the economic effects of soil erosion in the Meja watershed's Abay basin. The findings showed that erosion has a tremendous impact both economically and enviornmentally on the livelihoods of people in the watershed and basin. During the 3 months that soil erosion measurements were recorded, there was a total of 6812 tons of sediment loss from the watershed. In terms of this kind of sediment loss on livelihoods, it is estimated that the local people must wait at least 7 to 9 years to reverse this lost soil assuming erosion can be stopped. This comes out to a lost of 1200-2260 birr/ha for residents in the Meja watershed due to sediment loss alone. In addition, it was found that one of the most significant economic losses of erosion in the watershed was the loss of runoff water, which accounted for 24.9 billion m3 of water in the form of runoff during the rainy season in the area. This amounts to a major loss of water that could be used during the dry season through water harvesting technologies.

The following recommendations were provided based on the study's findings. (1) Any interventions and prescribing solutions better to give priority to those erosion prone indentified areas in the study watershed and when erosion is more hazardous i.e. at the beginning of the rainy season; (2) Runoff water harvesting should be an opportunity for enhancing rural livelihoods and food security and at the same time minimize the risk of erosion in the watershed and the basin; (3) Nutrient loss should give due attention along with soil loss through awareness creation for land users in any watershed management interventions in simultaneously reverse the land degradation; (4) The data can also be used to calibrate, validate, and evaluate models to provide valuable information in evaluating land management alternatives to help find solutions for land degradation of the watershed; (5) and Further work is therefore needed to determine the dynamic watershed response of runoff and erosion process to specify different land use scenario especially for eucalyptus plantations on their land.

4.5 Nile 5

The Nile 5 is the final component of the NBDC which acts as a catalyst to coordinate efforts across the projects. In essence, N5 is the glue that holds everything together. Its primary objective is to bring actors from various NBDC projects together to act as “one single project team, delivering promised and emerging outputs as required and using technical, institutional and advocacy strategies to bring about change in the way research, development and policy actors work in the basin [From: NBDC Brief 8. Feb. 2012. Communicating inside out – The NBDC's first year]."

One of the key components of N5 is the establishment of a National Platform. A platform is a mechanism to stimulate interaction and to improve coordination, sharing and learning, and create institutional change. Often platforms are part of a learning alliance which refers to a learning network operating at different scales, and which offers opportunities for out and up-scaling of best practices and lessons learned. [From: Report of a Planning Workshop on a National Innovation Platform on Land and Water Management in Ethiopia, Addis Ababa, April 8, 2011]. The National Platform was initiated by the NBDC in collaboration with other key players in land and water management (with support of the MoA). The national platform is a mechanism to bring different type of actors together for sharing and learning, identify ‘best’ practices, and to provide policy recommendations, but it is also an experiment in itself; how can a national platform best contribute to this. So far 4 National Platform meetings have been organized (including the orientation workshop). The first two meeting were mainly about the design of the platform, the next two were focused on a specific theme [From: the science contributions worksheet submitted in April 2013 on National Platforms].

Several reports have been produced through the NBDC project around strengthening the mechanism for an effective national platform. A technical report that explored the key national policies with respects to rainwater management in Ethiopia was submitted in July 2011. The objective of the report was to assess the policy environment in terms of the existence or absence of supportive policy and institutions and enabling environment for the promotion of rainwater management. Five major challenges were identified with respect to policy implementation. These are: policies are made without adequate assessment and drawing lessons of existing/old policies (strategies); lack or absence of policy implementation guidelines, laws and regulations; a general lack of policy implementation capacity at all levels; a general lack of proper policy implementation, monitoring and evaluation system that could feed into policy refinement and adjustment; and the challenge of policy coordination and integration (across sectors) [From: NBDC Technical Report 2. The development of key national policies with respect to rainwater management in Ethiopia: A review. Ethiopian Economics Association. July 2011].

Another report by a master's student at Haramaya University explored different types of communication tools for improved knowledge sharing in rainwater management. The paper looks at NBDC stakeholders' understanding of rainwater management concepts and practices as well as challenges in knowledge sharing. All three BDC field sites were examined. In Jeldu, a sampling was taken in three randomly selected kebalas, representing 5% of the population. The findings showed a broad range of perceptions and understanding on basic concepts and practices of RWM. Farmers were found to have limited knowledge and practical know-how on scientific RWM concepts and practices, with close to half of the respondent farmers (41.7%) not familiar with the term “rainwater management." Professionals on the other hand focused more on technological aspects of RWM than on enabling institutional innovation. Common challenges for improved knowledge sharing identified by the stakeholders included knowledge sharing difficulty with model farmers, lack of constant follow up and resources to translate knowledge into practice among farmers and lack of commitment, different professional approaches, varying interest, lack of strong network and lack of enabling technologies and knowledge management professionals. In addition, the study revealed that communication and knowledge sharing tools used by training facilitators were not suitable to the majority of farmers. Farmers preferred a more practical oriented training sessions with demonstrations and field visits and with audio-visual tools like video, films and radio programs as teaching aids [From: Elias Damtew Assefa. Communication tools for improved knowledge sharing in rainwater management: a case study of the nile basin development challenge. Haramaya University, April 2012].